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A New Approach to Inventorying Army Hazardous Materials, A Study Done for the Eighth U.S. Army, Korea Volume I: The Inventory Method

by
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FOREWORD

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This investigation was performed by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (USACERL). The principal investigator was Dr. Byung J. Kim. Mr. Yong H. Lee is a graduate student with the University of Illinois at Urbana-Champaign, responsible for the computer-programming aspect of this study. Dr. James Hartman is Chief and Mr. Naim Qazi is Assistant Chief of USFK/EUSA EPO. Appreciation is owed to Mr. Frank Maurer of Logistics Control Activity (LCA), Presidio, San Francisco, CA for providing the computer data for this project. Special thanks is given to COL E. Kane, 19th Support Command Engineer, and COL Robert Brown, USFK/EUSA Assistant Chief of Staff Engineer, for their understanding and support of the EUSA hazardous waste program. Mr. Donald Willard, of Illinois State University, is acknowledged for validating the data by comparing actual hazardous material data at Camp Carroll with the report data. Dr. Edward Novak is Acting Chief, USACERL-EN. The USACERL technical editor was Mr. William J. Wolfe, Information Management Office.

COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

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A NEW APPROACH TO INVENTORYING ARMY HAZARDOUS MATERIALS, A STUDY DONE FOR THE EIGHTH U.S. ARMY, KOREA VOLUME I: THE INVENTORY METHOD

1 INTRODUCTION

Background

The Hazardous and Solid Waste Amendment (HSWA) of 1984 declared hazardous waste reduction to be a national U.S. policy. Army Regulation (AR) 200-1[1] establishes the goal of the Army hazardous waste minimization program to achieve 50 percent reduction of hazardous waste generated before the close of calendar year (CY) 1992 when compared to a baseline of CY 1985. AR 200-1 further states that hazardous material management is to be considered an integral part of the Army's hazardous waste minimization program. However, present Army hazardous waste minimization and management programs have focused on the reduction of "end of pipe" waste generation and have paid little attention to hazardous material management.

Installations have been conducting a hazardous waste generation inventory to meet the U.S. Environmental Protection Agency (USEPA) or State biannual reporting requirements, or to measure the progress of an installation hazardous waste minimization program. In fact, hazardous material inventories have been often conducted by safety officers, preventive medicine officers, environmental coordinators, or environmentally conscious supply officers on their own initiatives. A thorough hazardous material inventory should be the first step to effectively manage hazardous materials. The U.S. Army Construction Engineering Research Laboratory (USACERL) has developed a bar code system to track all hazardous materials that enter and exit Army installations.[2] As yet, the systems have not been fully implemented, since the Army has not adopted consistent guidelines on how installations should conduct a systematic hazardous material inventory.

There is a need for a method to inventory hazardous materials and to collect the resulting data for participating installations. The United States Forces Korea (USFK)/ Eighth United States Army (EUSA) Environmental Programs Office tasked USACERL to develop such a method to conduct a hazardous material inventory in EUSA installations. This methodology may also be used in other installations. This study will also provide general information regarding the kinds of hazardous materials that enter and exit Army installations.

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[1] Army Regulation (AR) 200-1, *Environmental Protection and Enhancement* (Headquarters Department of the Army [HQDA], April 1990), Para. 6-6.b.(1).

[2] Michael Kemme et al., *Development and Application of Bar Code-Based Hazardous Material and Hazardous Waste Tracking Systems at U.S. Army Installations*, Draft Technical Report (U.S. Army Construction Engineering Research Laboratory [USACERL], September 1991).

Objectives

The objectives of this study were to: (1) develop a method to inventory hazardous materials without extensive field survey, and (2) provide hazardous material inventory data for EUSA installations.

Approach

USACERL-developed Hazardous Material Identification (HMID) data were used to filter supply data from Logistics Control Activity (LCA), Presidio, San Francisco. The resulting data were compared with the Material Safety Data Sheet (MSDS) in the Hazardous Material Information System (HMIS). The common elements of LCA data and HMIS were compiled, analyzed, and validated.

Scope

The accuracy of information is contingent upon the basic data which came from LCA, Presidio, San Francisco. Local purchase data was not evaluated. Hazardous material was defined based on the MSDS definition, which is broader than the U.S. Department of Transportation's (DOT's) hazardous materials or USEPA's hazardous waste definitions. Since mass balance of hazardous materials and waste is extremely difficult, the hazardous material inventory data is not directly usable for hazardous waste management.

Mode of Technology Transfer

It is recommended that information in this report be included in the EUSA hazardous waste management and minimization plans. This report will also serve as a reference for the Army Environmental Office, EUSA, and Army communities to better explain the EUSA hazardous waste management and minimization program, and to further develop overseas installation hazardous waste minimization strategies. Workshops are planned to help train EUSA personnel in the implementation of this strategy.

2 HAZARDOUS MATERIAL DATA

Needs for Hazardous Material Inventory

Proven methods for successful hazardous waste minimization for industries are to:

1. Change materials purchasing and control methods
2. Improve housekeeping practices
3. Substitute less toxic materials
4. Recycle or reclaim wastes
5. Segregate wastewater flows
6. Reduce wastewater flows
7. Change production methods
8. Treat waste to reduce volume or toxicity
9. Delist wastes.[3]

Of these nine successful methods, the first four are hazardous material management-related methods. Whatever method is used, a hazardous materials inventory should be the first step to start systematic hazardous waste minimization program.

Definition of Hazardous Materials

Figure 1 shows a hazardous material and hazardous waste flow diagram for Army activities. Black arrows indicate hazardous materials flow, and white arrows hazardous waste flow. Hazardous materials were originally defined by the Hazardous Materials Transportation Act (HMTA), and hazardous waste is defined by the Resource Conservation and Recovery Act (RCRA). The primary differences between DOT hazardous materials and USEPA hazardous waste are:

- EPA's "ignitable" characteristic is much broader than DOT's "flammable."
- EPA does not regulate nonflammable gases, but DOT does.
- EPA's "corrosive" characteristic uses pH as a measure, whereas DOT's does not.
- EPA regulates corrosive liquids only, whereas DOT regulates both liquids and solids.
- EPA's "Toxic Characteristics Leaching Procedure (TCLP) toxicity" does not correlate with DOT's definitions of poisons.[4]

The hazardous materials shown in Figure 1 may include all DOT-defined hazardous materials and materials that will become EPA-defined hazardous wastes when disposed of. In the Department of Defense, the hazardous properties that are to be recycled by generators and for which reutilization, transfer, donation, or sales (RTDS) actions are not determined by the Defense Reutilization and Marketing Offices (DRMO), are hazardous materials by definition.

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[3] Higgins, T.E., *Hazardous Waste Minimization Handbook* (Lewis Publisher, Inc., Chelsea, MI, 1989).
[4] Bierlein, L.W., *Red Book on Transportation of Hazardous Materials* (Van Nostrand Reinhold Co., New York, NY, 1988).

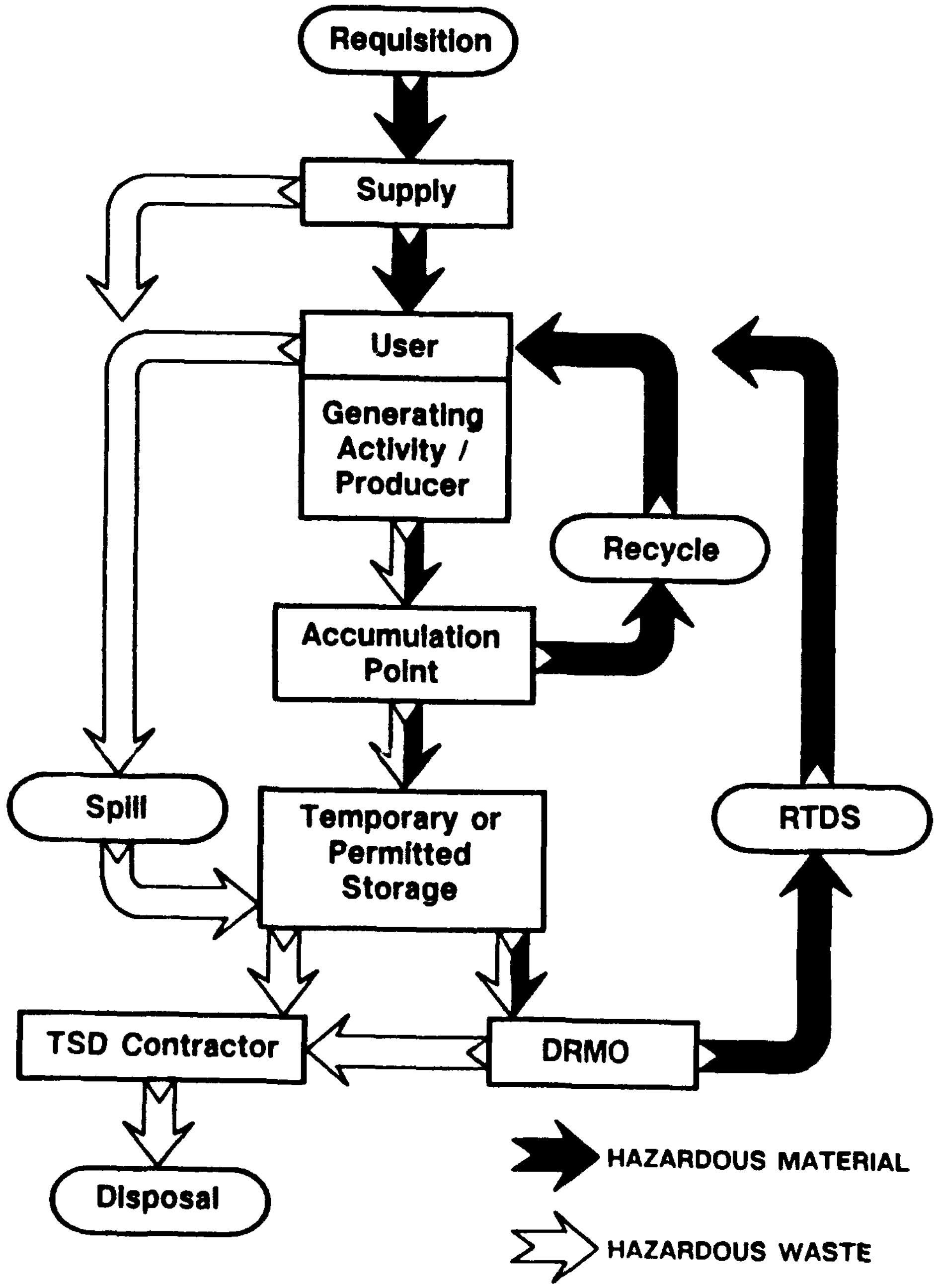

Figure 1. Hazardous Material and Hazardous Waste Flow Diagram.

For the purposes of this report, hazardous materials are defined as any materials received at EUSA installations with an MSDS. For hazardous material to have an MSDS, it must be a material having one or more of the following characteristics:[5]

- A health hazard or physical hazard as defined in 29 CFR 1910.1200(c).[6] Health hazards include materials that are carcinogens, corrosive materials, highly toxic materials, irritants, sensitizers, toxic materials, or materials that damage the skin, eyes, or internal organs. Physical hazards include combustible liquids, compressed gases, explosives, flammable materials, organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials and water reactive materials

- Hazardous waste characteristics defined by the USEPA under 40 CFR 261

- Hazardous or dangerous characteristics for transportation regulated by DOT under 49 CFR 171-179

- Hazardous or dangerous characteristics in accordance with the Dangerous Goods Regulations of the International Air Transport Association (IATA) and the Maritime Dangerous code of the International Maritime Organization (IMO)

- Radioactive characteristics regulatcd under 10 CFR

- Classification as hazardous in Air Force Regulation (AFR) 71-4

- Containing asbestos, mercury, or PCB

- Magnetic qualities regulated under 49 CFR

- A flash point below 200 °F (°C = [°F − 32] × 1.8) closed cup, or an ability to spontaneous heat or polymerize with release of large amount of energy when handled, stored, and shipped without adequate control

- Is a flammable solid as defined in 49 CFR 173.150, or is an oxidizer as defined in 49 CFR 173.151

- A probability that accidents, leaks, or spills during normal operations may produce dusts, gases, fumes, vapors, mists, or smokes with one or more of the above characteristics

- Special characteristics that, in the opinion of the manufacturer or the Government, could harm personnel if used or stored improperly.

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[5] Federal Standard No. 313E, *The Preparation and Submission of Material Safety Data Sheets* (General Services Administration, April 1983).

[6] Title 29, Code of the Federal Regulations (CFR), 1984 rev., Part 1910.1200, "Occupational Safety and Health Administration Directives to the Hazard Communication Standard."

This report was not intended to provide a mass balance between hazardous materials and waste. Although the mass balance approach for hazardous materials and waste is theoretically possible, it is extremely difficult in field conditions. The reasons are:

1. Hazardous waste information is compiled and reported by calendar year. Hazardous material requisition and usage, and hazardous waste generation are lengthy processes that may not occur in the same calendar year.

2. Many hazardous materials are used up and do not generate hazardous waste. Actual usage data is not available.

3. The definitions of hazardous materials and waste are different. Hazardous waste managers use USEPA hazardous waste definitions. Sometimes States and local governments have their own definition. Hazardous material handlers and users are unsure how to correctly identify and manage substances in the face of many different and apparently incompatible regulations. For instance, Army supply uses National Stock Number (NSN), hazardous waste generators are required to use the USEPA hazardous waste codes, and the Defense Reutilization and Marketing Service (DRMS) uses the contract line item number (CLIN).

4. Many hazardous materials are purchased directly through local manufacturers. Such products have no assigned NSNs, and would therefore complicate a mass balance approach based upon the model described in this report.

A New-Approach Inventory

In this study, the USACERL-developed Hazardous Material Identification (HMID) data and HMIS' MSDS were compared, and the common elements of the two bodies of data were extracted for analysis.

The USACERL-developed HMID, a subset of Hazardous Waste Management Information System (HWMIS), contains hazardous material data. The data sources were the Logistics Intelligence File (LIF) and Central Demand Database (CDDB) maintained by the Logistics Control Activity (LCA), Presidio, CA. HMID hazardous materials used three screening criteria:

1. Materials with the codes listed in "Appendix G: Codes Used in the Hazardous Materials Columns of the Freight Classification Guide System," in AR 55-355, *Defense Traffic Management Regulation.*[7] The same codes are also listed in Table 7-35 "Hazardous Material Code," in AR 708-1 *Cataloging and Supply Management Data.*[8] The Hazardous Material Code is a two-position alphabetic code that represents peculiar shipping conditions. It generally indicates hazardous or dangerous article descriptions that must be shown on the bill of the lading.

2. All class III supply Petroleum, Oils, and Lubricants (POLs).

3. Federal Supply Class (FSC) 6505 materials (hospital, infectious).

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[7] AR 55-355, *Defense Traffic Management Regulation* (HQDA, July 1986).

[8] AR 708-1, *Cataloging and Supply Management Data* (HQDA, September 1986).

HMID data from LCA indicated that there were 12,885 transactions with 4147 National Stock Numbers (NSN) in FY89 and 21,552 transactions with 7906 NSNs in FY90.

The Hazardous Material Code FF was most often encountered in the HMID: 3104 transactions with 782 NSNs in FY89, and 2787 transactions with 946 NSNs in FY90. The Code FF denotes special factors or conditions in an item description that affect the ratings or charges. These special factors and conditions are not necessarily related to the hazardous material characteristics. Neither POL items nor hospital materials are necessarily hazardous materials. Therefore, the HMID data provided much larger data entry than the hazardous material list sought.

Occupational Safety and Health Administration (OSHA) Regulation, 29 CFR 1910.1200 requires hazard communication to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards are transmitted to affected workers. This transmittal of information is to be accomplished by a written hazard communication program, labels and other forms of warning, MSDSs, and training. Employers are required to maintain copies of the appropriate MSDS for all chemicals in the workplace readily accessible or available to workers. Paragraph 4.e. of Army Regulation (AR) 700-141 *Hazardous Materials Information System (HMIS)* requires the Commanding General of the Army Materiel Command (AMC) to direct the AMC Catalog Data Activity (CDA) to assume responsibility as the Army's focal manager for MSDSs. DOD 6050.5-L and 6050.5-LR compile MSDS in the Compact Disc-Read Only Memory (CD-ROM) as an element of the Hazardous Material Information System (HMIS). Although the definition of hazardous materials in MSDSs is broader than that of DOT's hazardous materials or EPA's hazardous waste, HMID data could be substantially reduced by intersecting with MSDS data, so that: (1) the number of transactions were reduced from 12,885 to 3289 in FY89 and from 21,552 to 5699 in FY90, and (2) the number of NSNs was reduced from 4147 to 833 in FY89 and from 7906 to 1618 in FY90. Consequently, this new method successfully eliminated the unnecessary portion, about three-fourths of the total data size.

One way to improve HMID hazardous material data was to eliminate FF code items. The number of transactions with FF code was 3104 with 782 NSNs in FY89, and 2787 with 946 NSNs in FY90. After intersecting HMID data with MSDS data, the number of transactions was 98 with 21 NSNs in FY89, and 14 with 8 NSNs in FY90. The results showed FF code items to be insignificant after comparing data, indicating that most FF code items were not hazardous materials.

Another method to be considered is using FSC. A 13-digit stock number consists of a four-digit FSC and a nine-digit National Item Identification Number (NIIN). The first two digits of NIIN represent the National Codification Bureau (NCB) Code. Goods produced in the United States are designated by NCB codes 00 and 01. Table 1 shows FSCs in which most items are hazardous, i.e., for which MSDS should be submitted.[9]

There are 59 FSCs, which require MSDS if the item is hazardous.[7] Table 2 shows 10 example FSCs, which most frequently appear in Army hazardous material inventory lists. When HMID data is sorted by the 25 FSCs in Tables 1 and 2, HMID data could be even further reduced. However, the hazardous materials that do not have the 25 FSCs would be missed. Furthermore, each FSC contains some nonhazardous materials. Therefore, HMID data and all NSNs with MSDS were compared and the common elements of the two bodies of data were compiled for analysis.

[9] Federal Standard No.313E, *The Preparation and the Submission of Material Safety Data Sheets* (General Services Administration, April 1983).

Table 1

FSCs Requiring MSDSs

FSC	Title
6810	Chemicals
6820	Dyes
6830	Gases: compressed and liquefied
6840	Pest control agents and disinfectants
6850	Miscellaneous chemical specialties
7930	Cleaning and polishing compounds and preparations
8010	Paints, vanishes, and related products
8030	Preservative and sealing compounds
8040	Adhesives
9110	Fuels, solid
9130	Liquid propellants and fuels, petroleum base
9135	Liquid propellent fuels and oxidizer, chemical base
9140	Fuel oils
9150	Oils and greases: cutting, lubricating, and hydraulic
9160	Miscellaneous waxes, oils, and fats.

Table 2

FSCs Most Frequently on Army Hazardous Material List

FSC	Title
4120	Fire-fighting equipment
5910	Capacitors
6120	Transformer: distribution and power station
6135	Batteries, primary
6140	Batteries, secondary
6505	Drugs, biological, and official reagents
6750	Photographic supplies
8120	Commercial and industrial gas cylinders
8145	Specialized shipping and storage containers
8720	Fertilizers

3 SUMMARY OF HAZARDOUS MATERIAL DATA

All hazardous material data collected in this study is presented in tabular form in the unattached appendix to this report (Volume II).

DODAAC Addresses in EUSA

Table A1 shows a EUSA Department of Defense Activity Address Code (DODAAC) list identified with Directorate of Engineering and Housing (DEH) jurisdiction. Table 3 lists the DEHs in EUSA.

Data by the National Stock Number

Tables A2 and A3 list 833 and 1618 NSNs that were shipped to EUSA installations in FY89 and FY90 respectively. Only FY90 data is analyzed and presented in this report since FY89 data was only for the last two quarters and appeared less comprehensive. Table A4 lists hazardous materials by requesting DODAACs. Tables A5-a through Table A12-a list hazardous material NSNs that were shipped to each DEHs during FY90.

Tables A5-b through A12-b list NSNs in numerical order and include nomenclature, hazardous material code, fiscal quarter shipped, requesting DODAAC, receiving DODAAC, unit, requested total quantity, and delivered total quantity.

Data by the Requesting DODAAC

Tables A5-c through A12-c list requesting DODAAC in alphanumerical order. Under each DODAAC, all hazardous materials shipped to that DODAAC were listed. Requesting DODAACs were listed instead of receiving DODAACs because there were too many undetermined "Y" codes for receiving DODAACs. If receiving DODAAC information was fully available, their address codes would provide a more logical starting point for analysis.

Table 3

EUSA DEHs

DEH Code	DEH Name
2ID	DEH-2ID
WC	DEH-Western Corridor
CFA	DEH-CFA
3	DEH-Yongsan
2	DEH-Camp Page
6	DEH-Camp Humphreys
5	DEH-Taegu
7	DEH-Pusan

Validation

Since Camp Carroll acts as a depot for other U.S. Army installations in Korea, it generates more hazardous waste than all other EUSA installations combined. Camp Carroll's personnel do actual inventory counts of hazardous wastes, making the data taken at Camp Carroll a good objective standard for judging other methods for recording hazardous waste data. USACERL obtained Camp Carroll's extensive hazardous material survey results, which were compared with the data in this report. The inventory indicated 1468 NSNs were stored in Camp Carroll. This report data showed that 823 NSNs in the two quarters in FY89 and 1229 NSNs in FY90 were shipped to DEH Taegu. The NSN number shown in Camp Carroll's inventory but not shown in this report data was 809 in FY89 and 560 in FY90. NSN numbers shown in this report data but not in the Camp Carroll inventory, were 181 NSNs in FY89 and 321 NSNs in FY90. The number of NSNs shown in the both data collections was 642 in FY89 and 908 in FY90.

The FY90 data in this report has proven to be valuable: A single year of supply data in this report represented 67 percent of Camp Carroll's entire hazardous material inventory. In addition, 321 new NSNs were identified as potential inventory items in DEH Taegu.

4 SUMMARY AND RECOMMENDATIONS

This report has provided a new method to conduct a hazardous material inventory. Based upon this method, hazardous material inventory data for EUSA installations are developed. The new approach used USACERL-developed HMID data to screen supply data from LCA, Presidio, CA. HMID hazardous material meet three criteria:

1. Materials with codes listed in Appendix G of AR 55-355
2. All Class III supply POLs
3. FSC 6505 materials (hospital, infectious).

Further analysis was done to categorically restrict the list to hazardous materials. Since MSDSs already identify hazardous materials and hazardous waste, MSDS data is used to screen the HMID. Common elements of the two bodies of data form a list that includes hazardous and possibly hazardous materials (in this case, the composite list eliminated about three-fourths of the nonhazardous data from the list). The resulting data showed FF-code items to be overwhelmingly nonhazardous or insignificant in number.

The hazardous material data presented in this report is the first step in an effort to create a successful Army hazardous waste minimization and management program. Such a program will require a consistent, coordinated effort among hazardous material supply personnel, handlers, and users; hazardous waste generators and disposal personnel; as well as safety officers and environmental coordinators.

Further research is recommended to investigate how to better track hazardous materials and hazardous waste. For example, it would be useful to devise a method to include locally purchased hazardous materials in the hazardous materials data base. Also, to aid in tracking hazardous materials and wastes, the Army needs to develop a system to correlate NSNs, USEPA hazardous waste codes, and DRMS' CLINs. For more effective hazardous material management, the system could be used to approve/disapprove the requisition of those hazardous materials for which less hazardous substitutes have been identified. The system would need to be updated as materials are received and as supplies are depleted to yield a truly real-time accounting tool.

It is also recommended that the Eighth U.S. Army, DEHs, and environmental coordinators follow up this report by analyzing the fate of each hazardous material (i.e., actual usage; waste generation volume; and recycling, treatment, and disposal methods). Use of these inventory methods, together with consistent recordkeeping methods can help in better understanding hazardous material management, and result in a more successful Army hazardous waste minimization program.

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